# Space Weather Technical Forecast

Issued on Tuesday, 20 February 2024 at 00:35 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

## Space Weather Forecast Headline: Ongoing Chance of R1. Slight Chance G1 Tuesday 20 February.

### Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity has remained Low over the UTC day of Monday 19 February with X-ray flares at GOES16 confined to C-class, peaking with a C6.7 flare at 19/0940UTC from AR3590 near the eastern solar horizon.

There were five sunspot regions on the visible disc, with the nominal threat of flares dominated by the departing AR3583 in the northwest as an Fso/Beta-Gamma, and by the arriving AR3590 in the northeast as an Ehi/Beta-Gamma. Other sunspots were relatively magnetically simple and largely unchanged in the 24 hours.

A prominence eruption was noted on H-Alpha around 19/0100UTC. A disappearing filament then left the southwest disc just before 19/1800UTC. The former has been analysed and does not intersect the ecliptic, however analysis to determine any effects arising from the latter is awaiting imagery. Finally, late in the period around 19/2300UTC, a dimming and probable CME was observed from the vicinity of AR3583, at the same time a prominence was seen to depart the southwest limb, with imagery confirming any ICMEs pending in both cases. At the time of writing, no new Earth-directed Coronal Mass Ejections (CMEs) were noted.

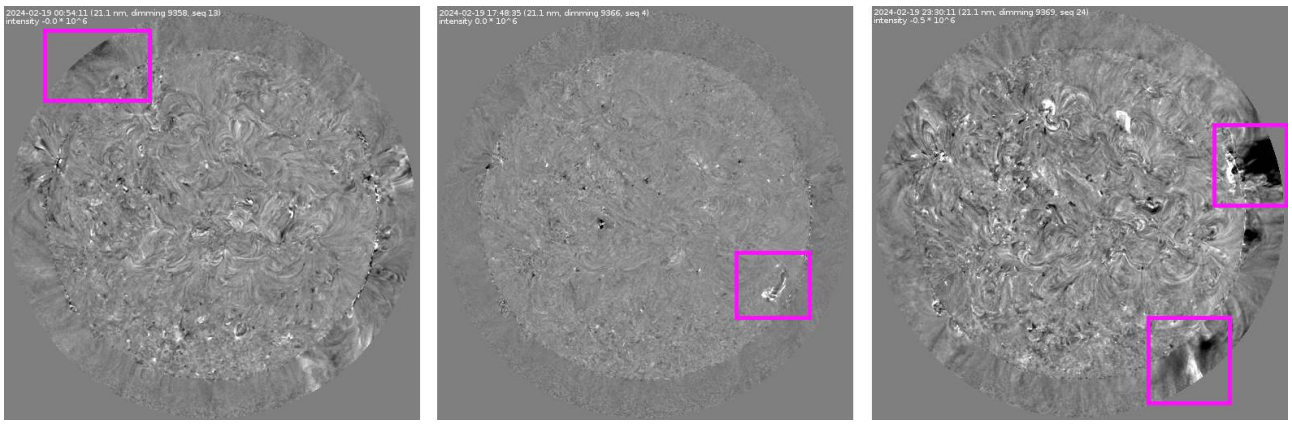

**Figure 0: SIDC ROB processed time-integrated AIA211 dimmings seen in the 24 hours, with main events shown boxed in magenta. The leftmost is confirmed as missing Earth, however the remaining three are yet to be assessed.**

**Solar Wind / Geomagnetic Activity:** Solar winds, as recorded at L1 by ACE and DSCOVR, were reflective of a slow solar wind regime. The solar wind speed was steady at Background levels between 275 and 325km/s. The solar wind density showed a slight rise over the same period, but remaining within typical single figures ppcc. The IMF was smooth and stable below 5nT, with a gradual rotation of the north-south component from co-aligned (+3nT) to anti-aligned with Earth's

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field (-3nT). The phi angle was positive (away from the Sun) for the vast majority of the period.

The net result of the above solar wind measures was for provisionally Quiet geomagnetic activity throughout, with Kps of 0 or 1.

**Energetic Particles / Solar Radiation:** GOES18 high energy (greater than 10MeV) proton flux was just above resting Background levels but on a continuing declining trend.

Electron flux (greater than 2MeV) has been at Normal Background levels, with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 20/0001UTC was 1.1e6 integrated pfu.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Low activity is most likely to continue, but with a daily Chance of rising to Moderate. This chance is rated roughly constant through the four days, with arriving eastern limb regions roughly compensating for western limb losses.

**Solar Wind / Geomagnetic Activity:** A CME which left the Sun on 16 February may glance the Earth during the first half of day one, Tuesday 20 February, but with low confidence. Solar wind speeds are otherwise expected to remain at ambient levels, with no high speed streams forecast to connect with the Earth.

Geomagnetic activity is forecast to be mainly Quiet, with a Slight Chance of Unsettled or Active intervals on Tuesday 20 February due to the potential CME arrival.

**Energetic Particles / Solar Radiation:** GOES18 high energy (greater than 10MeV) proton flux will continue to gradually ease to Background, but with a Slight Chance of further enhancement until around midweek UTC should any appropriate flares occur from AR3576 just over the limb or from AR3583 approaching it.

High energy electron flux (greater than 2MeV) is expected to remain at Normal Background levels. The associated 24-hour electron fluence is expected to stay below the Active threshold.

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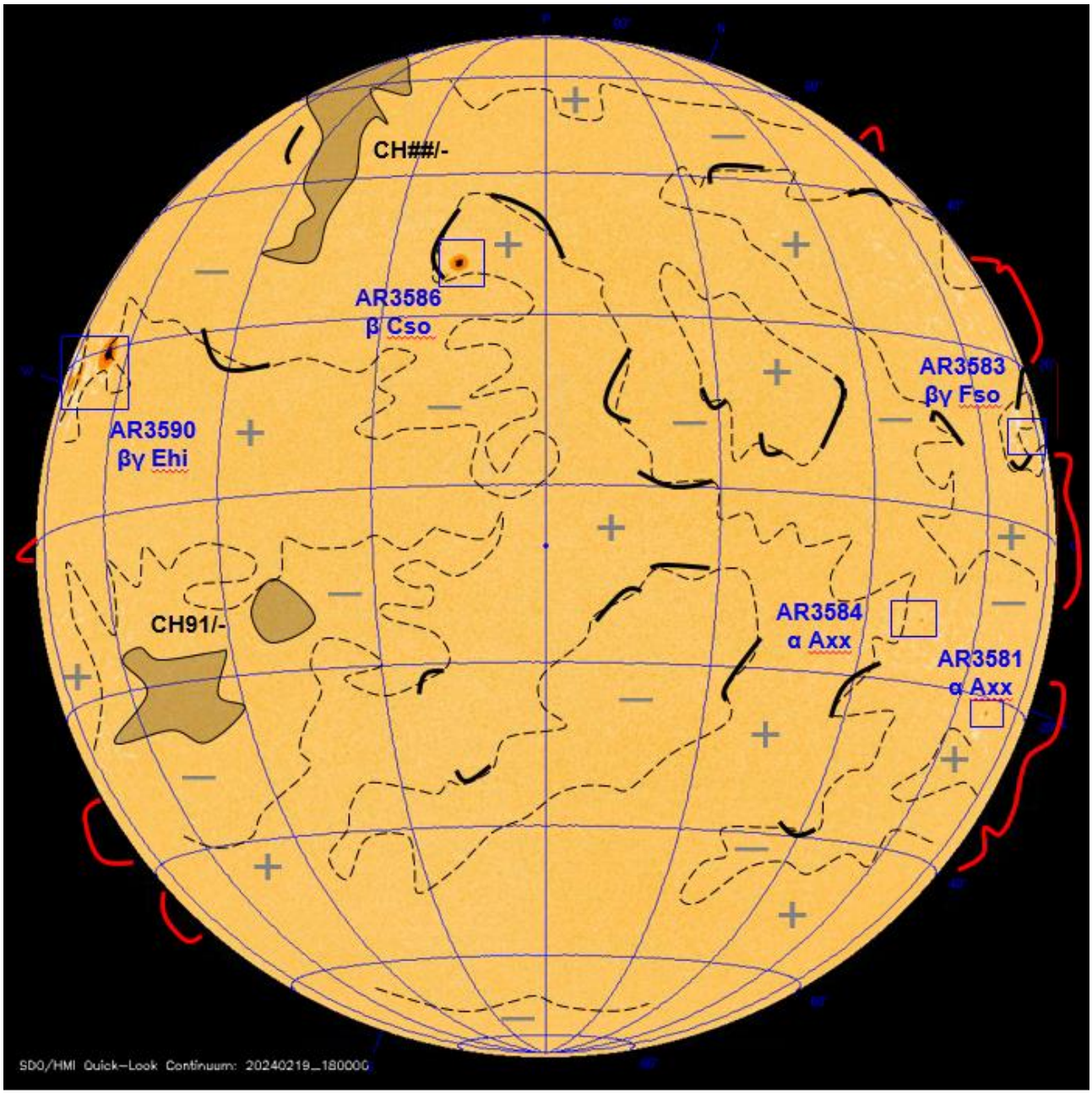
**Figure 1. Solar Analysis Valid 19/1800UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

There is one potentially Earth-directed CME in the forecast. This is a filament eruption which left the north-centre disc on 16 February. This feature is now on the longer end of arrival time estimates and may pass Earth as a glance during the first half of day one, Tuesday 20 February.

Solar wind speeds are otherwise expected to remain at ambient levels through the remainder of the UTC working week. No significant coronal holes are present on the visible disc, with CH91 currently too far eastward to feature and a further hole in the northwest quadrant considered likely to lie too far north to affect the Earth.

Geomagnetic activity is forecast to be mainly Quiet, with a Slight Chance of Active or perhaps G1/Minor Geomagnetic Storm intervals on 20 February due to the risk of the CME arrival.

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 5 | 1 | 1 | 1 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

| Date/time 21.5R (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed | Estimated Arrival Time | Comments |
|---|---|---|---|---|---|---|
| 16/0755 | Nil | Filament | NW | 770km/s | Early 20 February UTC day | Now-reduced likelihood of glance. |

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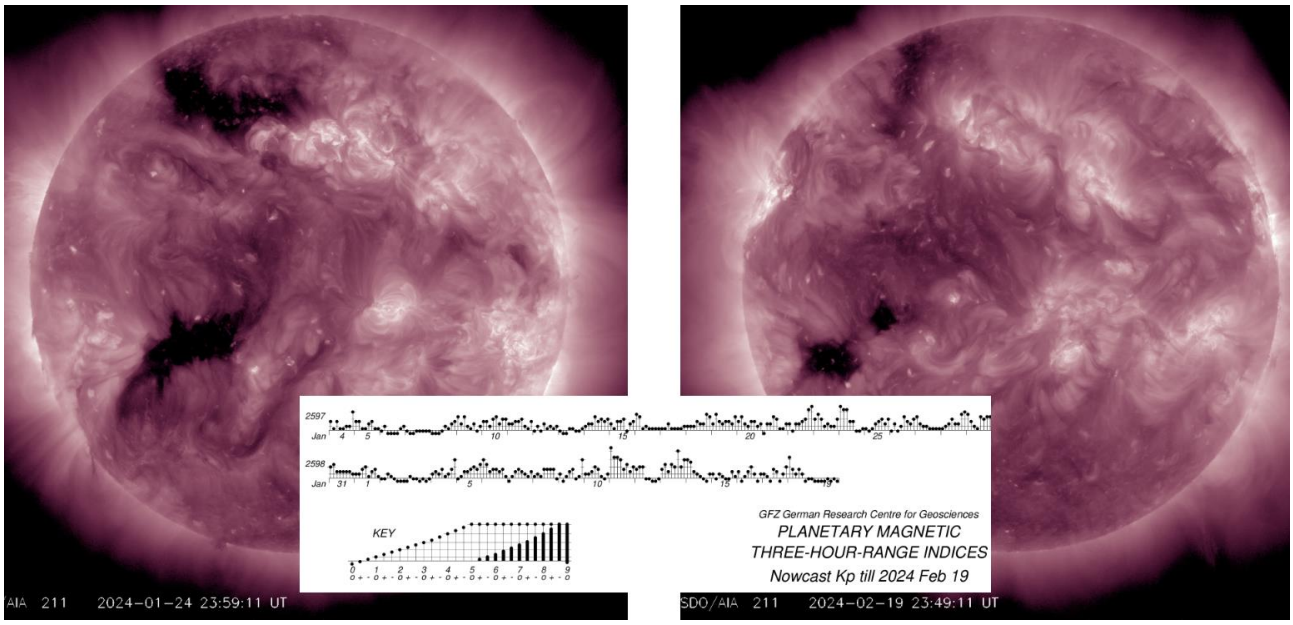
**Figure 2: Current and previous rotations' coronal hole configurations, as seen on AIA211. The features on the current disc can be seen to have atrophied somewhat, and in any case presented minimal enhancement on last pass.**


AIA 211 2024-01-24 23:59:11 UT
GFZ German Research Centre for Geosciences
PLANETARY MAGNETIC
THREE-HOUR-RANGE INDICES
Nowcast Kp till 2024 Feb 19
SDO/AIA 211 2024-02-19 23:49:11 UT

## Radio Blackouts - X-Ray Flares:

Low solar activity is most likely through the period, but with an increasing likelihood of Moderate activity, due to a large contribution from AR3590 near the eastern limb, and perhaps soon Ex-AR3575 which is also expected to rotate onto the southeast limb from around 21 February. These regions should theoretically make up for the shortfall of AR3583's passing onto the far side in the coming 24 hours, and hence a steady trend of a Chance of M-class flares is maintained through the next four days. Having said this, the character of AR3590 has yet to be fully determined, and some revision of the level of the advertised flat risk is possible once AR3590's behaviour becomes more fully known, i.e. not relying solely on its Zurich class.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 35 | 35 | 35 | 35 |
| Very Active | R3 to R5 X Class | No | 5 | 5 | 5 | 5 |

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**Figure 3: SIDC ROB sources of X-ray flares of C-class and above in the 24 hours of the UTC day of Monday 19 February, showing AR3590 and offgoing AR3583 as almost exclusively the sources.**

## Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) protons have continued their gradual decline towards resting background levels in the past 24 hours, with no new enhancements seen since 16 February.

AR3576 will now give a decreasing risk for further proton enhancements as it moves across the western limb to the far side in the first 24 hours of the period. Remaining regions on the Earth-facing disc have a lower chance of notable flares, and are currently considered unlikely sources of further solar storms, with the nominally more potent AR3590 currently not in favourable location to connect with Earth should it flare appropriately on the eastern limb.

| **Radiation Storms** | **Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$)** | **Past 24 Hours (Yes/No)** | **Day 1 (00-24 UTC)** | **Day 2 (00-24 UTC)** | **Day 3 (00-24 UTC)** | **Day 4 (00-24 UTC)** |
|---|---|---|---|---|---|---|
| **Probability (Exceedance)** | | | **(%)** | **(%)** | **(%)** | **(%)** |
| **Active** | **≥ S1** | No | 5 | 2 | 2 | 1 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

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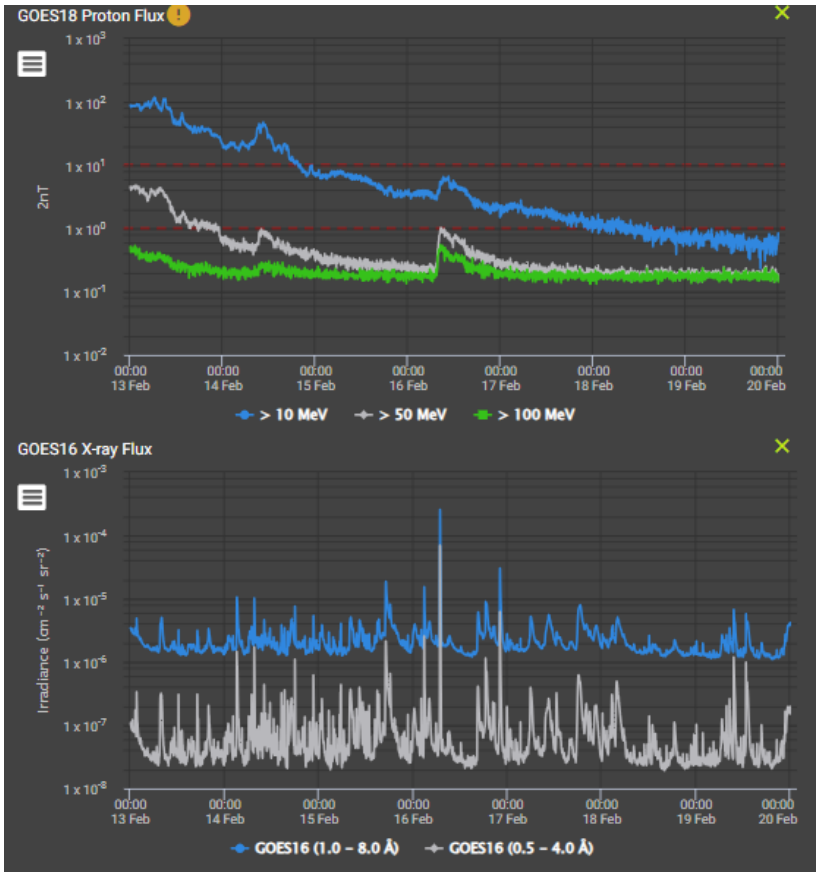
**Figure 4: The past week in GOES18 high energy proton flux levels and GOES16 X-ray flares. This picture shows an overall decline, with the exception of a brief blip due to X-class activity on 16 February.**




## High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to be muted through much of the period, with no recurrent feature on the disc having proved capable of generating Active fluence in the past rotation. The only source of enhancement possible in the period is the now-reduced likelihood of a potential CME arrival in the first half of day one, Tuesday 20 February. This is forecast to be a glancing blow, with limited charging of the electron belts. MOSWOC REFM is not indicating any significant enhancement in the period, however note that the dominant influence on electrons in the period is transient-related and not recurrent.

| **GEO Electron Environment** | **Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$)** | **Past 24 Hours (Yes/No)** | **Day 1 (00-24 UTC)** | **Day 2 (00-24 UTC)** | **Day 3 (00-24 UTC)** | **Day 4 (00-24 UTC)** |
|---|---|---|---|---|---|---|
| **Probability (Exceedance)** | | | **(%)** | **(%)** | **(%)** | **(%)** |
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 1 | 1 | 1 | 1 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

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